## REMARKS

Claims 1-6, 29-35, 38-41, 43, and 44 are pending in the application. Claims 1-6, 29-35, 38-41, 43, and 44 stand rejected. Claim 35 is being amended to correct minor informalities. No new matter is believed to be introduced by the amendment.

**Rejections Under 35 U.S.C. §103(a)**

Claims 1, 4-6, 29-30, 32-34 were rejected under 35 U.S.C. §103(a) as being unpatentable over Alamouti *et al.* (U.S. Patent No. 5,933,421, hereinafter referenced as "Alamouti") in view of Paulraj *et al.* (U.S. Patent Number 5,345,599, hereinafter referenced as "Paulraj"), further in view of Jenness (U.S. Patent No. 5,373,300, hereinafter referenced as "Jenness"), and further in view of Bell (U.S. Patent No. 6,115,762, hereinafter referenced as "Bell").

Claim 1 recites:

> In a multi-point communications system having a receiver and transmitter disposed at a primary site for communication with a plurality of remote units disposed at respective secondary sites, an antenna comprising:
>
> multiple receiving elements configured to receive communications signals over a carrier frequency from the plurality of remote units, at least two receiving elements configured to receive the communication signals on a same frequency band during any period of time, the receiving elements being partitioned into a plurality of groups disposed remotely from one another by at least a predetermined minimum group spacing sufficient to obtain spatial diversity, each group containing at least one receiving element, at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering. *(emphasis added)*

In contrast to Applicants' Claim 1, Alamouti employs a system where a base station Z receives a first incoming signal, including a plurality of first Orthogonal Frequency Division Multiplexed (OFDM) frequency tones F2 in a first frequency band from a first remote station U during a first Time Division Multiple Access (TDMA) interval. The base station Z also receives a second incoming signal, including a plurality of second OFDM frequency tones F4 in the first frequency band from a second remote station W during a second TDMA interval. Thus, the first and second remote stations, U and W, receive the first and second sets of discrete frequency

tones F2 and F4 during different periods of time (see Fig. 1 and Column 9, line 19-65 of Alamouti).

Thus, Alamouti does not teach or suggest "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time, the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," as required by Applicants' Claim 1.

Paulraj describes a spatial filter in which signals received from a receiver front-ends are separated into multiple distinct transmitted components. The spatial filter includes a group of channels, each of which accepts the received signals and operates on them with single or multi-tap tapped delay line filters with adjustable weights. The spatial filter employs *a priori* information and input and output signals of the spatial filter to determine the optimum weights used for weight adjustment. The outputs of the spatial filter are sent to a demodulator or decoder for further processing.

Thus, Paulraj merely describes a spatial filter that includes a group of channels, each of which accepts received signals and operates on them using adjustable weights. Paulraj does not teach or suggest "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time, the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," as required by Applicants' Claim 1.

Jenness merely describes that antenna devices utilized for cellular communication generally include multiple antenna elements. These multiple antenna elements include elements which are separated by a minimum distance and preferably must be oriented normal to each other in space, in order to provide the necessary separation and spatial diversity needed for enhancing the efficiency of communication (see column 1, line 63 to column 3, line 5, as also referenced by the Office Action). Although Jenness explains that the antenna elements need to be separated by a minimum distance, nowhere in Jenness is there mention of the antenna "elements being partitioned into a plurality of groups" such that "at least one group

includes[es] multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering."

Bell separates receiving antenna elements an appropriate distance, relative to the wavelength of the signal to be received, to design a system in which one of the antenna elements will be in a position where the signal has not experienced significant degradation due to multi-path effects (see column 3, line 53 to column 4, line 5, as also referenced by the Office Action). Similar to Jenness, although Bell explains that the antenna elements are separated by an appropriate distance, nowhere in Bell is there mention of the antenna "elements being partitioned into a plurality of groups" such that "at least one group includes[es] multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering."

A hypothetical system combining the teachings of Paulraj, Alamouti, Jenness, and Bell may include antenna elements positioned at preset or appropriate distances from one another, but the hypothetical system would not include partitioning receiving elements "into a plurality of groups," neither would the hypothetical system ***within each group*** include "multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing."

Additionally, one of ordinary skill in the art would not be motivated to modify the hypothetical system to include "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time, the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," because these references are not designed to operate within each partitioned group; rather, they are designed to operate without partitioning the receiving elements into groups. Therefore, a modification that would enable the hypothetical system to operate within the partitioned group would be substantial and would only be done in hindsight of Applicants' teachings.

Therefore, it is Applicants' position that Claim 1 is allowable over Paulraj in view of Alamouti, Jenness, and Bell. Accordingly, Applicants respectfully request that the rejection of this claim under 35 U.S.C. § 103(a) be withdrawn.

Claim 29 includes similar elements as Claim 1. Accordingly, Applicants respectfully request that the rejection of this claim under 35 U.S.C. § 103(a) be withdrawn.

Because Claims 4-6, 30, and 32-34 depend from Claims 1 and 30, Applicants respectfully submit that these claims should be allowed for at least the same reasons as the base claims from which they depend.

**Claims 2 and 30**

Claims 2 and 30 were rejected under 35 U.S.C. §103(a) as being unpatentable over Alamouti in view of Paulraj, in view of Jenness, further in view of Bell, and further in view of Gardner (Patent No. 5,260,968, hereinafter referred to as Gardner).

Gardner is being combined with Alamouti, Paulraj, Jenness and Bell because these references do not teach "receiving element spacing no more than one half time a wavelength." Gardner may do so, but Gardner does not teach or suggest having "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time, the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," as required by Applicants' Claims 1 and 29.

A hypothetical system combining the teachings of Alamouti, Paulraj, Jenness, Bell, and Gardner may have receiving element spacings of no more than one half time a wavelength, but it will not have "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time, the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering." One of ordinary skill in the art would not be motivated to modify the hypothetical system to be configured to receive the communication signals on a same frequency band at any period of time because such

modification would require altering the operating principles of the hypothetical system and enabling the hypothetical system to operate within the partitioned group. Therefore, such modification would require substantial alteration and would only be done in hindsight of Applicants' teachings.

Accordingly, Applicants respectfully request that the rejection of Claims 2 and 30 under 35 U.S.C. § 103(a) be withdrawn.

**Claims 3 and 31**

Claims 3 and 31 were rejected under 35 U.S.C. §103(a) as being unpatentable over Alamouti in view of Paulraj, in view of Jenness, further in view of Bell, and further in view of Chang *et al.* (Patent No. 5,414,433, hereinafter referred to as Chang).

Chang is being combined with Alamouti, Paulraj, Jenness, and Bell because these references do not teach a "predetermined minimum spacing no more than five times a wavelength." However, Chang does not teach or suggest having "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time, the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," as required by Applicants' Claims 1 and 29.

A hypothetical system combining the teachings of Alamouti, Paulraj, Jenness, Bell, and Chang may be able to have a predetermined minimum spacing, but it will not have "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time, the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering." One of ordinary skill in the art would not be motivated to modify the hypothetical system to be configured to receive the communication signals on a same frequency band at any period of time because this modification would need to alter the operating principles of the hypothetical system and enable the hypothetical system to operate within the partitioned

group. Therefore, such modification would require substantial alteration and would only be done in hindsight of Applicants' teachings.

Accordingly, Applicants respectfully request that the rejection of Claims 3 and 31 under 35 U.S.C. § 103(a) be withdrawn.

**Claim 35**

Claim 35 was rejected under 35 U.S.C. §103(a) as being unpatentable over Alamouti in view of Paulraj, in view of Jenness, further in view of Bell, and further in view of Reece *et al.* (Patent No. 5,771,024, hereinafter referred to as Reece).

Claim 35 recites:

> An adaptive antenna array architecture for communication, the architecture comprising:
> a plurality of adaptive antenna arrays for signal reception, wherein the plurality of adaptive antenna arrays including a plurality of sub-arrays, each sub-array including at least two receiving elements, the receiving elements in the sub-arrays being no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering, wherein the sub-arrays being spaced to obtain spatial diversity;
> an array fixation structure configured to position the plurality of adaptive antenna arrays;
> an array support structure for positioning the array fixation structure at a desired elevation; and
> a base station configured to control the adaptive antenna array architecture.

Reece is being combined with Alamouti, Paulraj, and Gardner because these references do not teach "an array fixation structure configured to mount the plurality of adaptive antenna arrays thereon." However, Reece merely relates to an antenna mount and does not teach or suggest having, "plurality of adaptive antenna arrays including a plurality of sub-arrays, each sub-array including at least two receiving elements, the receiving elements in the sub-arrays being no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," as required by Applicants' Claim 35.

A hypothetical system combining the teachings of Alamouti, Paulraj, Jenness, Bell, and Reece may have an array fixation structure for mounting the plurality of adaptive antenna arrays,

but it will not have "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time, the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering." One of ordinary skill in the art would not be motivated to modify the hypothetical system to be configured to receive the communication signals on a same frequency band at any period of time because this modification would need to alter the operating principles of the hypothetical system and enable the hypothetical system to operate within the partitioned group. Such modification would require substantial alteration and would only be done in hindsight of Applicants' teachings.

Accordingly, Applicants respectfully request that the rejection of Claim 35 under 35 U.S.C. § 103(a) be withdrawn.

**Claims 38 and 39**

Claim 38 was rejected under 35 U.S.C. §103(a) as being anticipated by Paulraj in view of Forssen *et al.* (Patent No. 5,566,209, hereinafter referred to as "Forssen").

Claim 38 recites:

> A signal receiver for receiving communications signals, the receiver comprising:
> an adaptive array configured to receive signals from remote units;
> a plurality of demodulator units configured to process the signals;
> a plurality of beamformers for configured to construct a desired signal response as a function of direction of arrival data of the signals; and
> a spatial diversity combiner configured to remove interference from the signals.

In contrast, Paulraj employs a combiner that is "simply a d-way multiplexer" (see column 8, lines 11-49 and shown in Figs. 5 and 6 of Paulraj) that receives the demodulator/decoder signals, aligns the signals to compensate for differential delays experienced by the signals, and combines the time aligned signals to obtain an estimated source stream. Although Paulraj employs the direction of arrival information to separate co-channel signals into individual signals prior to feeding them into his demodulators, nowhere in Paulraj is there mention of employing the direction of arrival information to construct or combine the signals input to his combiner 98.

Thus, Paulraj does not employ a combiner that constructs "a desired signal response as a function of direction of arrival data of the signals," as required by Applicants' Claim 38.

Forssen employs an adaption means to adjust spatial filters used to enhance a desired spatial channel (e.g., a training sequence) while suppressing other spatial channels. The adaption means can adjust the spatial filters in a variety of ways, for example, direction of arrival estimation combined with classification and weighting, direction of arrival estimation combined with least squares minimization of an error signal, direction of arrival estimation with least means squares minimization of an error signal, and direction of arrival estimation combined with a gradient optimizing method can be used to optimize the spatial filters using any known optimization method (see Forssen, column 4, lines 38-57, as also referenced by the Office Action).

Thus, Forssen merely employs direction of arrival data in combination with factors such as weighting and minimization of an error signals to enhance a training sequence used as a desired signal. Foressen does not teach or suggest a combiner that constructs "a desired signal response as a function of direction of arrival data of the signals," as required by Applicants' Claim 38.

A hypothetical system combining the teachings of Paulraj and Forssen may have a direction of arrival processor but it will not have a combiner that constructs "a desired signal response as a function of direction of arrival data of the signals." One of ordinary skill in the art would not be motivated to modify the hypothetical system to include a combiner that constructs "a desired signal response as a function of direction of arrival data of the signals" because such modification requires significant alteration of the hypothetical system and would only be done in hindsight of Applicants' teachings. Specifically, since Foressen merely takes in training sequence and employs the training sequence as its desired signal, one would need to modify the hypothetical system to instead construct the desired signal. Such modification clearly would require substantial alteration of the hypothetical system and would only be done in hindsight of Applicants' teachings.

Accordingly, Applicants respectfully request that the rejection of Claim 38 under 35 U.S.C. § 103(a) be withdrawn.

Claim 39 was rejected under 35 U.S.C. §103(a) as being unpatentable over Paulraj in view of Forssen *et al.* (Patent No. 5,566,209, hereinafter referred to as "Forssen").

Forssen is being combined with Paulraj because Paulraj does not teach a "direction of arrival processor configured to calculate the direction of arrival." However, Forssen does not teach or suggest having "a plurality of beamformers configured to construct a desired signal response as a function of direction of arrival data of the signals," as required by Applicants' Claim 38.

A hypothetical system combining the teachings of Paulraj and Forssen may have a direction of arrival processor but it will not have "a plurality of beamformers configured to construct a desired signal response as a function of direction of arrival data of the signals."

Accordingly, Applicants respectfully request that the rejection of Claim 39 under 35 U.S.C. § 103(a) be withdrawn.

**Claim 40**

Claim 40 was rejected under 35 U.S.C. §103(a) as being unpatentable over Paulraj in view Foressen and further in view of Alamouti.

Alamouti and Foressen are being combined with Paulraj because Paulraj does not teach employing OFDM. However, Alamouti and Foressen are do not teach or suggest having "a plurality of beamformers configured to construct a desired signal response as a function of direction of arrival data of the signals," as required by Applicants' Amended Claim 38, from which Claim 40 depends.

A hypothetical system combining the teachings of Paulraj, Foressen, and Alamouti may employ OFDM, but it will not have "a plurality of beamformers configured to construct a desired signal response as a function of direction of arrival data of the signals."

Accordingly, Applicants respectfully request that the rejection of Claim 40 under 35 U.S.C. § 103(a) be withdrawn.

**Claim 41**

Claim 41 was rejected under 35 U.S.C. §103(a) as being anticipated by Ward *et al.* (U.S. Patent Number 6,104,930, hereinafter referenced as Ward) in view of Langlais (U.S. Patent No.: 6,091,932, hereinafter referenced as Langlais).

Claim 41 recites:

> A method for reducing signal interference, the method comprising:
> assigning at least one frequency bin to a user;
> spacing the at least one frequency bin belonging to the user to at least one sufficiently different frequency as a function of minimizing signal strength of active bins to reduce inter-bin interference; and
> locating the at least one frequency bin with at least one frequency bin of other users such that directions of arrival for the users are distinctly separable.

In contrast to Applicants' Claim 41, Ward merely employs a system where "each beam is substantially spatially fixed and the beams operate at carrier frequencies which are sufficiently separated from each other so as not to cause interference with each other, or with other beams radiating in adjacent cells" (see column 8, lines 6-10 and Fig.7 of Ward). Although Ward discusses separating beams based on their carrier frequencies to ensure that they do not interfere with each other, nowhere in Ward is there mention of spacing the frequency bins based on minimizing signal strength of active bins.

Thus, Ward does not employ a combiner that spaces "the at least one frequency bin belonging to the user to at least one sufficiently different frequency as a function of minimizing signal strength of active bins to reduce inter-bin interference," as required by Applicants' Claim 41.

Langlais merely increases a sample period by "100's to 1000's of times." As such, the symbol times are made to be much longer than significant echo paths and inter-symbol interference is prevented (see column 4, lines 52-55, as also referenced by the Office Action).

Thus, Langlais merely increases symbol period to prevent inter-symbol interference. Langlais does not employ a combiner that spaces "the at least one frequency bin belonging to the user to at least one sufficiently different frequency as a function of minimizing signal strength of active bins to reduce inter-bin interference," as required by Applicants' Claim 41.

A hypothetical system combining the teachings of Ward and Langlais may prevent inter-symbol interference, but it will not employ a combiner that spaces "the at least one frequency bin belonging to the user to at least one sufficiently different frequency as a function of minimizing signal strength of active bins to reduce inter-bin interference."

One of ordinary skill in the art would not be motivated to modify the hypothetical system to include a combiner that spaces "the at least one frequency bin belonging to the user to at least one sufficiently different frequency as a function of minimizing signal strength of active bins to reduce inter-bin interference" because such modification requires significant alteration of the hypothetical system and would only be done in hindsight of Applicants' teachings. For example, the hypothetical system would need to be modified to space frequency bins belonging to the user to at least one sufficiently different frequency in order to minimize signal strength of active bins. Such modification requires significant alteration and would only be done in hindsight of Applicants' teachings.

Accordingly, Applicants respectfully request that the rejection of Claim 41 under 35 U.S.C. § 103(a) be withdrawn.

**Claim 43**

Claim 43 was rejected under 35 U.S.C. §103(a) as being unpatentable over Ward. However, as discussed above, Ward does not employ a combiner that spaces "the at least one frequency bin belonging to the user to at least one sufficiently different frequency as a function of minimizing signal strength of active bins to reduce inter-bin interference," as required by Applicants' amended Claim 43.

Accordingly, Applicants respectfully request that the rejection of Claim 43 under 35 U.S.C. § 103(a) be withdrawn.

**Claim 44**

Claim 44 was rejected under 35 U.S.C. §103(a) as being anticipated by Ward in view of Langlais.

Claim 44 recites:

> A method for avoiding interference in communications signals, the method comprising:

partitioning available bandwidth into a plurality of frequency blocks, the frequency blocks including a plurality of bins;

assigning a user to a bin in each of the frequency blocks; and

distributing the bins within the frequency blocks as a function of power of the bins.

In contrast to Applicants' Claim 44, Ward maintains a pool of unassigned and allowable carrier frequencies. Depending on the number of incoming calls, individual carrier frequencies are allocated based on traffic activity. Ward monitors underutilized carrier frequencies (i.e., carrier frequencies having a number of vacant communication channels) and reallocates these time slots to other carrier frequencies on the beam (see column 10, line 37 to column 11, line 42 of Ward).

Langlais merely increases a sample period by "100's to 1000's of times." As such, the symbol times are made to be much longer than significant echo paths and inter-symbol interference is prevented (see column 4, lines 50-61, as also referenced by the Office Action). Nowhere in Langlais is there mention of "distributing the bins within the frequency blocks as a function of power of the bins," as recited in Applicants' Claim 44.

Thus, neither Ward nor Langlais teach or suggest "distributing the bins within the frequency blocks as a function of power of the bins," as required by Applicants' amended Claim 44.

A hypothetical system combining the teachings of Ward and Langlais may prevent inter-symbol interference, but it will not employ a combiner that "distributes[ing] the bins within the frequency blocks as a function of power of the bins."

One of ordinary skill in the art would not be motivated to modify the hypothetical system to include a combiner that "distributes[es] the bins within the frequency blocks as a function of power of the bins," because such modification requires significant alteration of the hypothetical system and would only be done in hindsight of Applicants' teachings. For example, the hypothetical system would need to determine power of the bins and distribute the bins based on the power of the bins. Such modification requires significant alteration and would only be done in hindsight of Applicants' teachings.

Accordingly, Applicants respectfully request that the rejection of Claim 41 under 35 U.S.C. § 103(a) be withdrawn.

## CONCLUSION

In view of the above amendments and remarks, it is believed that all currently pending claims, claims 1-6, 29-35, 38-41, 43, and 44 are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

HAMILTON, BROOK, SMITH & REYNOLDS, P.C.

By Mark B Solomon

Mark B. Solomon
Registration No. 44,348
Telephone: (978) 341-0036
Facsimile: (978) 341-0136

Concord, MA 01742-9133
Date: 7/15/09